USE OF TEXTURE FADING IN THE TREATMENT OF FOOD SELECTIVITY

Bridget A. Shore and Roberta L. Babbitt

KENNEDY KRIEGER INSTITUTE

AND JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

KEITH E. WILLIAMS

PENNSYLVANIA STATE UNIVERSITY

David A. Coe

MIAMI CHILDREN'S HOSPITAL

AND

Angela Snyder

KENNEDY KRIEGER INSTITUTE

Children with feeding disorders often display severe food selectivity. For many of these children, consuming highly textured foods may be aversive or potentially dangerous because of frequent gagging. The purpose of this study was to demonstrate the efficacy of texture fading in the treatment of food selectivity displayed by 4 children. Treatment involved the gradual addition of higher textures based on the results of periodic probes. In addition, food acceptance and swallowing were reinforced, while food refusal and food expulsion were placed on extinction. Results showed that all participants successfully advanced to consumption of age-appropriate texture and volume. The results suggest that texture fading with intermittent probes at higher textures may be an effective method for the treatment of food selectivity by texture.

DESCRIPTORS: food refusal, food selectivity, stimulus fading, behavioral medicine, children

Feeding difficulties and dietary inadequacies have been reported to occur in approximately one third of children with developmental disabilities and in as many as 80% of children with severe or profound disabilities (Palmer, Thompson, & Linsheid, 1975; Perske, Clifton, McClean, & Stein, 1977). In addition, inadequate intake has been re-

ported to cause 20% of all childhood dietary insufficiencies (Palmer & Horn, 1978). A frequently encountered problem among children with feeding disorders is food selectivity by texture. For many of these children, consuming highly textured food may be aversive because of frequent gagging and may be potentially dangerous because of the increased risk of aspiration.

Stimulus fading procedures, in which stimulus control over one behavior is transferred to another behavior by gradually changing antecedent stimuli, have been used to treat food refusal and food selectivity (Johnson & Babbitt, 1993; Kerwin, Ahearn, Eicher, & Burd, 1995; Luiselli & Gleason,

Reprints may be obtained from Bridget Shore, Kennedy Krieger Institute, Department of Behavioral Psychology, 707 North Broadway, Baltimore, Maryland 21205.

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1987). Johnson and Babbitt, for example, treated the solid-food refusal of a 4-year-old boy with multiple handicaps by using stimulus fading to transfer control from a previously accepted regular baby bottle of diluted pureed foods, to undiluted pureed foods from the bottle, and finally to undiluted foods presented from a spoon. Similarly, in a study examining the effects of amount of food presented on the relative acceptance of food, Kerwin et al. showed that increasing the serving size of foods presented (empty, dipped, quarter, half, and level) was effective in treating the chronic food refusal of 3 children with total food refusal.

Luiselli and Gleason (1987) reported the use of stimulus fading by combining sensory reinforcement with increasingly higher textured food to treat chronic food refusal. A 4-year-old child with visual and hearing impairments was treated for food refusal by turning on a light and rocking the child contingent on food consumption, and by gradually increasing the food's texture. Five levels of food texture were presented in increasing order, with texture increasing as consumption at each previous level met either a subjective criterion based on staff clinical judgment (Levels 1 through 3) or a more objective criterion of 100% acceptance for two to three consecutive weeks (Levels 4 and 5). Results showed that the procedure was effective in increasing the child's solid-food consumption from a pureed baby food texture to a finely diced texture.

Although the Luiselli and Gleason study (1987) illustrates the potential efficacy of fading food texture, several limitations of the study are worth noting. First, because there was only 1 participant in the study, the generalizability of results is unknown. Second, the use of subjective criteria for fading texture makes systematic replication of the procedures very difficult. Third, the number of experimental manipulations and lack of experimental control preclude conclusions

concerning the efficacy of the treatment. The purpose of the current study was to demonstrate the efficacy of texture fading with periodic probes at higher textures, combined with reinforcement and extinction procedures, in establishing higher texture food consumption by children who display food selectivity.

METHOD

Participants and Setting

Three children (Trevor, Ray, and Julia) receiving inpatient treatment and 1 child (Andy) receiving outpatient treatment for feeding disorders at an urban pediatric hospital were participants for the study.

Trevor was a 3-year 8-month-old boy who had been admitted for 8 weeks for treatment of severe food selectivity by type and texture. His medical diagnoses included mild developmental delays in speech and language and a history of febrile seizures. Trevor's mother reported that, since the introduction of solid foods at 6 months of age, Trevor ate only preferred foods at pureed texture (custard, banana-tapioca, apple-banana, and applesauce) and refused all other food types and textures. Trevor used a spoon and regular cup to feed himself without problems.

Ray was a 3-year-old boy who had been admitted for 7 weeks for the assessment and treatment of bottle dependency and food refusal. His medical diagnoses included premature birth (24 weeks gestation), bronchopulmonary dysplasia, status postsurgery to correct an intestinal defect, blindness, and failure to thrive. He was reported to be functioning at the 16-month level for motor skills and at 12 months for language abilities. Upon admission, Ray was consuming all liquids through a bottle and pureed food through a cup with a nipple.

Julia was a 2-year 10-month-old girl who had been admitted for 8 weeks for the assessment and treatment of gastrostomy tube

dependence, food refusal, and chronic cyclical vomiting. Her medical diagnoses included severe gastroesophageal reflux, renal tubular acidosis, solitary kidney, and sensorineuro hearing loss. Julia's cognitive and physical developmental functioning were normal for her age. Upon admission, Julia was fed by gastrostomy tube for 100% of her nutritional needs.

Andy was a 5-year 2-month-old boy who had been admitted to an outpatient program for 5 weeks for the assessment and treatment of food refusal and food selectivity by texture. His medical diagnoses included craniosynostosis (repaired), severe mental retardation, hypotonia, and oral motor dysfunction. Andy's mother reported that he began refusing food at about 1 year of age, and since that time consumed only a few foods at a pureed texture (oatmeal, applesauce, ice cream, juice, and milk); although he would take small tastes of pancakes and cereal, he refused all other food types and textures of food.

An occupational therapist evaluated each child's feeding skills and recommended beginning textures and goal textures based on the results of modified barium swallow studies and clinical observations. Beginning textures were identified as pureed for Trevor, Ray, and Andy and junior texture for Julia. The target textures for texture fading were identified as chopped fine for Trevor, Julia, and Andy, and 50% chopped fine and 50% ground for Ray.

All meals were conducted in a room (2.5 m by 3 m) furnished with a high chair, a small table, and two chairs for observers. On one wall of the room was a one-way mirror through which caregivers or experimenters in an adjoining room could observe meals.

Dependent Measures

Treatment meals consisted of three meals per day, fed by one of three or four trained therapists for Trevor, Ray, and Julia. Andy's meals also consisted of three meals per day, which were conducted either at home or in an outpatient clinic by a trained therapist or by his mother. For all 4 children, occurrence data were collected for all target behaviors for each bite presentation.

An acceptance was defined as the child opening his or her mouth so that food or liquid could be delivered within 5 s after the spoon or cup was presented or touched to the lips. A swallow was defined as the child clearing his or her mouth of all food or liquid larger than the size of a pea within 30 s of the initial presentation of the food or drink without expelling (see below). An expulsion was defined as the child emitting any behavior (other than vomiting or salivating) that caused food or liquid larger than size of a pea, which was previously in his or her mouth, to be visible beyond the border of the lips or outside of the mouth prior to the next bite. A gag was defined as the child making retching or choking sounds before presentation of the next bite or, in the absence of sound, hyperextending the neck, tensing the neck muscles, opening the mouth, or protruding the tongue from the mouth.

Percentage occurrence for the dependent variables was obtained by dividing the number of bites and drinks in which the response occurred by the total number of bites and drinks and multiplying by 100%. In addition to these behavioral measures, pre- and posttreatment food weights were recorded, and any amount of food spilled, vomited, or expelled was collected and weighted. Posttreatment weights plus weights of expelled, spilled, or vomited food were then subtracted from pretreatment weights to obtain number of grams consumed.

Interobserver Agreement

A second trained independent observer recorded occurrence data on target behaviors for each bite or drink offered. Occurrence,

nonoccurrrence, and total agreement were calculated for each behavior by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Interobserver agreement was obtained for 27.0% of Trevor's meals, 22.0% of Ray's meals, 30.4% of Julia's meals, and 39.0% of Andy's meals. Across behaviors and participants, mean interobserver agreement was 94.8% for occurrence (range, 64% to 100%), 94.2% for nonoccurrence (range, 64% to 100%), and 98.8% for total (range, 95% to 100%). Mean total agreement for each target behavior across participants was 99.6% for acceptances, 98.3% for swallows, 98.9% for gags, and 97.7% for expulsions. A second independent observer also recorded food weights before and after the meal and spilled, vomited, or expelled food after the meal. Mean interobserver agreement across participants for grams consumed was 99.6%.

Stimulus Preference and Reinforcer Assessments

Reinforcers were identified for use during treatment by conducting stimulus preference and reinforcer assessments (Fisher et al., 1994; Pace, Ivancic, Edwards, Iwata, & Page, 1985). During the stimulus preference assessment, the child was presented with a single stimulus, and the occurrence of approach, avoidance, or consumption of each item was recorded. During the reinforcer assessment, the top three to five preferred items identified in the preference assessment (highest approach plus consumed) were tested for reinforcer efficacy by providing access to the items contingent on the child sitting in a square or chair. The items with the longest duration of "in-square" behaviors were selected as reinforcers. Dinosaurs, a boom box, a See 'n' Say®, a musical piano, and a microphone were selected by Trevor; beads, keys, a tape player, and cars were selected by Ray; a doll, bubbles, and a toy hammer were

selected by Julia; and a doll, a pop-up toy, and a toy car were selected by Andy.

Treatment

During all beginning-texture, texture-fading, and probe meals, the same treatment components were in effect for Ray, Julia, and Andy. Treatment consisted of praise contingent on accepting bites or drinks, 15 s of toy play and praise contingent on swallowing bites or drinks, escape extinction for behaviors incompatible with acceptance (holding the spoon to his or her lips until an opportunity to deposit the food occurred), and extinction for expelling bites (placing expelled food back into the mouth until swallowed). For Trevor, treatment was identical to that for the other participants except that extinction for expelled bites was added after the 10th meal because expulsion did not occur at a high frequency until after texture fading had begun.

Progression of texture fading. The treatment for each participant remained in effect for all meals. All meals lasted 30 min or until age-appropriate portions had been consumed (amount of food recommended by a nutritionist), whichever occurred first. Beginning-texture meals consisted of food presented at the texture the child had been consuming at home prior to admission for Trevor, Ray, and Andy, and at the texture recommended by an occupational therapist (based on results of a modified barium swallow study) for Julia. When the child was successfully consuming the amount of food recommended by the nutritionist (target volume) at the beginning texture, probe meals were conducted at varying textures to determine the next texture for fading. The texture presentations occurred in the following sequence: 100% pureed, 100% junior, 100% ground, 100% chopped fine. The first probe involved the target texture. Success with any texture was defined as acceptances and swallows above 80% and expulsions and gags below 20%. If the probe meal did not meet these criteria, a second probe occurred at the next meal using the next higher texture from the previously successful texture. If this second probe was unsuccessful (Trevor only), bites consisting of a combination of two textures were presented using the following sequence: 75% previously successful texture/ 25% next texture, 50% previously successful texture/50% next texture, 25% previously successful texture/75% next texture, 100% next texture. Bites were presented using the same texture or combination of textures until the child met the criteria for success at three consecutive meals (two consecutive meals for Andy). If the probe meal met the criteria for success, meals were conducted at the probed texture. Following the successful completion of each 100% next texture, the sequence of probe meals was repeated.

Experimental Design

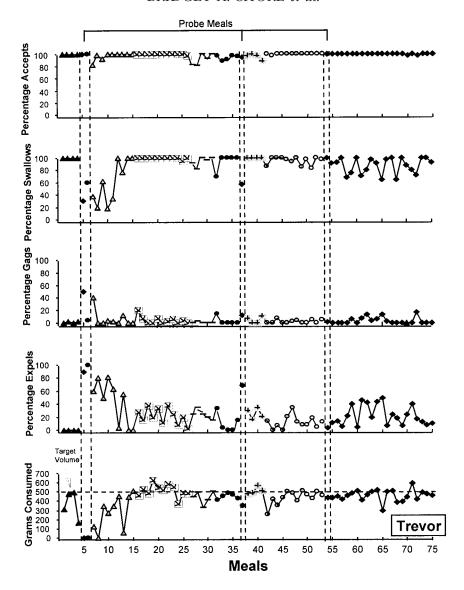
Probe meals using the target texture or the next full texture up from the previous full texture were conducted periodically as a method for identifying the next texture for treatment. A multiple baseline across subjects design was used to evaluate treatment efficacy.

RESULTS

Figure 1 shows the results for Trevor. The first four meals consisted of Trevor's beginning texture of pureed food. During these four meals, acceptances and swallows were 100% and expulsions and gags occurred at or near zero. A probe meal using his target texture of chopped fine food was then conducted and, although acceptances remained high, swallows dropped sharply and expulsions and gags increased. Therefore, a second probe was conducted using junior texture food (his next full texture up from pureed). During this probe, acceptances remained high at 100%, swallows rose slightly to 60%,

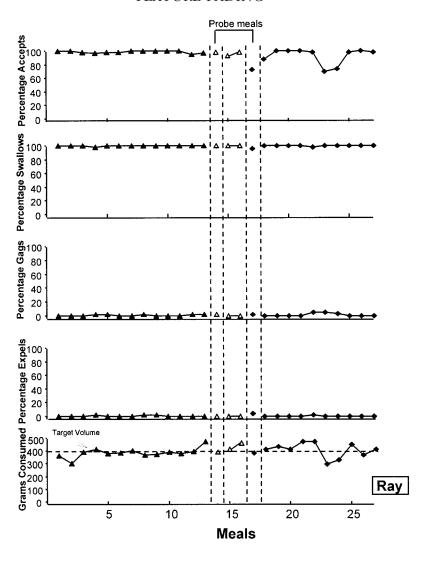
expulsions increased to 100%, and gags dropped to 10%. Because this probe did not meet the criteria for success, texture fading from pureed to junior was begun. During fading, acceptances remained high, but swallows were initially low and expulsions were high. With the addition of extinction for expulsions after the 10th meal, however, swallows increased and expulsions decreased. Gags were low and variable throughout this fading progression. When criteria for success were achieved, a probe meal was again conducted. During the target probe, acceptance was at 95%, swallows were 57%, expulsions were 67%, and gags were 10%. Because of the high percentage of expulsions, the progression of fading from junior to ground was begun. During fading, acceptances and swallows remained high, and gags and expulsions were low and variable. When criteria for success were reached, another target probe was conducted, during which acceptances and swallows were 100%, and gags and expulsions were low (0% and 6%, respectively). Therefore, meals using the target texture continued. During the final target texture meals, acceptances were high and stable, swallows were high and variable, gags were low, and expulsions were moderate and variable. Subsequent to the addition of extinction for expulsions during the initial texture fading, grams consumed remained at or near the target volume.

Figure 2 shows the results for Ray. The first 13 meals consisted of Ray consuming at or near his target volumes of the beginning-texture food (pureed). During these meals, acceptances and swallows were high, and expulsions and gags occurred at or near zero. A probe meal using his target texture of 50% ground and 50% chopped fine was then conducted, and acceptances and swallows remained high (98% and 100%, respectively), and expulsions and gags remained low (2% and 0%, respectively). Therefore, two more meals were conducted,



- Pureed texture
- 75% Pureed/25%Junior
- 50% Pureed/50% Junior
- 25%Pureed/75% Junior
- Junior texture
- 75% Junior/25%Ground
- 50%Junior/50%Ground 25%Junior/75%Ground
- Ground texture
- Chopped fine texture

Figure 1. Percentage occurrence of acceptances, swallows, gags, and expulsions, and number of grams consumed across meals for Trevor. The horizontal dotted line on the bottom graph indicates target volume.



- Pureed texture
- △ 50%:50%Ground/chopped fine texture
- Chopped fine texture

Figure 2. Percentage occurrence of acceptances, swallows, gags, and expulsions, and number of grams consumed across meals for Ray. The horizontal dotted line on the bottom graph indicates target volume.

and criteria for success were met with acceptances and swallows above 80% and gags and expulsions both at 0%. Given Ray's success at the 50% ground, 50% chopped fine texture, the occupational therapist revised her recommendation for target texture to full chopped fine, and a probe meal was con-

ducted at his new target texture. Acceptances fell slightly to 72%, swallows remained high at 96%, and gags and expulsions remained low (2% and 4%, respectively). Meals continued using the chopped fine texture, with acceptances high and somewhat variable, swallows high and stable, and gags and ex-

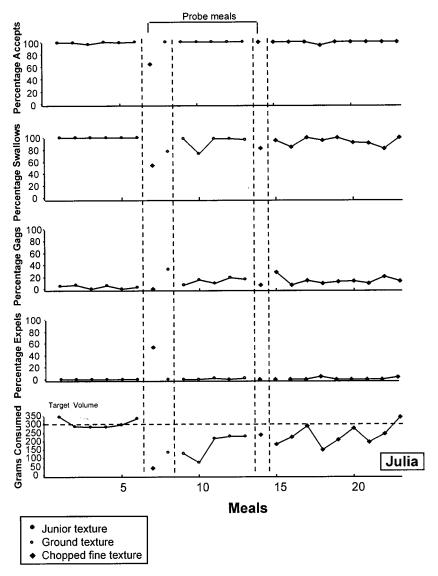


Figure 3. Percentage occurrence of acceptances, swallows, gags, and expulsions, and number of grams consumed across meals for Julia. The horizontal dotted line on the bottom graph indicates target volume.

pulsions low and stable. Throughout the entire progression, grams consumed remained high and somewhat variable, with Ray's target volume achieved by the end of the progression.

Figure 3 shows the results for Julia. The first six meals consisted of Julia consuming her target volume of her beginning-texture food (junior). During these six meals, acceptances and swallows were high and stable,

and gags and expulsions remained low. A probe meal was conducted at the chopped fine target texture. During this probe, acceptances dropped to 64%, swallows fell to 54%, gags were 0%, and expulsions were high at 54%. Therefore, another probe meal was conducted at ground texture (the next full texture up from junior). During this probe, acceptances were 100%, swallows were 77%, gags were 33%, and expulsions

were 0%. A clinical error occurred and meals were continued at the ground texture, but the criteria for success were met after five meals. Therefore, another probe meal at the chopped fine target texture was conducted. During this probe meal, acceptances and swallows were high (100% and 83%, respectively), and gags and expulsions were low (7% and 0%, respectively). Meals continued using the chopped fine texture; acceptances and swallows remained high, and gags and expulsions remained low.

Julia's number of grams consumed across meals was somewhat variable. During the beginning (junior) texture meals, number of grams consumed was high and stable. This measure dropped considerably, however, during the subsequent chopped fine and ground probe meals. Julia consumed fewer grams during ground and chopped fine meals than during beginning-texture meals, but her target volume consumption at the target texture was achieved during the final meal.

Figure 4 shows the results for Andy. The first six meals consisted of Andy's beginning texture of pureed food. During these six meals, acceptances and swallows were high and stable, and gags and expulsions were at 0%. Next, a probe meal at the chopped fine target texture was conducted, with a slight decrease in acceptances (80%), a substantial decrease in swallows (40%), a low level of gags (2%), and a high level of expulsions (60%). Therefore, a probe was conducted at junior texture (his next higher full texture). During this probe meal, acceptances and swallows were at 100%, and gags and expulsions were both at 0%. Therefore, meals continued at junior texture until the criteria for success were achieved. During meals at junior texture, acceptances and swallows remained high, and gags and expulsions remained low. Another probe meal at the chopped fine target texture was conducted, with a decrease in acceptances and swallows (74% and 92%, respectively), and a slight increase in gags and expulsions (both at 8%). Therefore, a probe meal was conducted at ground texture. During this probe meal, acceptances and swallows were high (97% and 91%, respectively), and gags and expulsions were low (13% and 9%, respectively). Meals continued using the ground texture until the criteria for success were achieved. During meals at ground texture, acceptances and swallows remained high, and gags and expulsions remained low. Another probe meal at chopped fine target texture was conducted, and acceptances and swallows were 100%, and gags and expulsions were 0%. Therefore, meals continued using chopped fine texture. During these final five meals, acceptances and swallows were high and variable, and although gags remained at 0%, expulsions were variable. Variability in this condition was associated with illness during 1 day of the treatment (Meals 17 and 18, see Figure 4). Throughout the entire progression, number of grams consumed remained high and variable, with Andy consuming his target volume during most

DISCUSSION

The results showed that a treatment package consisting of texture fading (with periodic probes at higher textures), reinforcement contingent on food acceptance and swallowing, and extinction of food refusal and food expulsion was effective in establishing consumption of higher texture food for 4 children with food selectivity. All 4 children consumed age-appropriate portions of their target food texture by the end of treatment. There were, however, idiosyncratic differences across children in how quickly the fading occurred. Texture fading progressed slowly for Trevor because of his persistence in expelling food throughout treatment. These data contrast sharply to Ray's

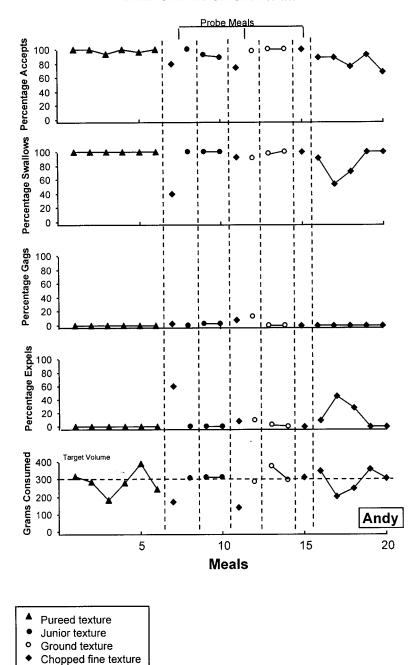


Figure 4. Percentage occurrence of acceptances, swallows, gags, and expulsions, and number of grams consumed across meals for Andy. The horizontal dotted line on the bottom graph indicates target volume.

treatment progression. The first probe meal at Ray's target texture met the criteria for success; thus, the occupational therapist adjusted her recommendation for target texture. In contrast, an intermediate step was necessary for Julia, with treatment at the next higher full texture from the beginning texture for success at her target texture. Finally, although Andy's treatment progressed quickly, treatment was necessary at two in-

termediate full textures before meeting criteria for success with his target texture.

Another difference among children occurred in number of grams consumed. When the entire treatment package was implemented across all meals, consumption was maintained for Trevor and Ray (bottom panels, Figures 1 and 2). Julia's consumption, however, decreased during the initial probe meals at chopped fine and ground textures, and remained lower than the beginning-texture meals when texture fading occurred. Andy's data (bottom panel, Figure 4) show a somewhat different pattern for this measure. Number of grams consumed was low during the first two target texture probes, but remained high for intermediate probes and texture-fading meals. These data suggest that, at least for Julia and Andy, texture fading may have been necessary to ensure adequate food consumption.

One limitation to this study is that the experimental design did not permit a complete systematic evaluation of the necessity of texture fading. That is, it is unknown whether implementing the reinforcement and extinction components while feeding the target texture (without the fading procedure) would have produced the same results. There is, however, some pragmatic justification for the use of texture fading. First, caregivers and the occupational therapist expressed concern over the child's gagging during previous attempts to feed higher texture foods. It is possible that treatment without fading could have produced, at least initially, higher amounts of gagging during meals, increasing the risk of aspiration. Second, all 4 children received their entire nutritional needs through these meals. The number of grams consumed by Julia and Andy suggest that volume may have been lost, at least initially, had fading not been used.

A second limitation is that, for Trevor, the addition of extinction for expelling bites was not added until the 10th meal. Therefore, it

cannot be determined whether the first two probe meals would have met the criteria for success if extinction had been implemented. Subsequent meals, however, suggested that expulsion would have still been a problem. Given that expulsions occurred throughout treatment, Trevor showed the greatest resistance to extinction for expulsion, suggesting that either texture was more aversive or his skill deficits were greater. Further research is needed to determine when or if additional treatment components are necessary to facilitate feeding skill acquisition (e.g., chew skill training) and to determine the function of food refusal and selectivity.

Another limitation can be found in Julia's treatment. The probe at ground texture showed gags at 33%. Therefore, the texture fading should have started at combined amounts of junior and ground texture rather than at full ground texture. Although this was a clinical error, the treatment at ground texture did not result in substantially higher amounts of gagging. This shows that, at least for Julia, the single probe meal was not an adequate reflection of what would occur if treatment were implemented at ground texture, and further brings to question the assessment method. Nevertheless, given the potential harmful effects of excessive gagging, erring on the side of caution seemed more prudent.

Considering the behavioral and medical characteristics of these children, it is not clear to what extent food selectivity by texture was a result of conditioned aversions, skill-based deficits, behavioral mismanagement, or all three variables. None of the children had previous experience in consuming the target texture foods, and all had physiological disorders that may have led to conditioned food aversions. For example, gastroesophageal reflux can lead to extreme discomfort while eating, often resulting in a conditioned aversion to food consumption (Hyman, 1994). A parent may deliver con-

tingent attention for inappropriate behavior at mealtimes (positive reinforcement) or terminate the meal (negative reinforcement) contingent on food refusal. Finally, a child may never have progressed beyond eating a smooth texture of food and therefore may never have developed the skills necessary for consumption of higher textured food. The extent to which these different functions contributed to the children's feeding disorders is not known. An analysis of the behavioral function of feeding disorders may lead to more effective treatments, and further research should be conducted to determine if and when various treatments are effective given differing maintaining variables.

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STUDY QUESTIONS

- 1. Why is food selectivity by texture problematic; that is, why is it important for children to learn to eat "higher" texture foods?
- 2. List the dependent variables and describe how they were measured.
- 3. How were reinforcers to be used during treatment identified?
- 4. Describe the contingencies that were in effect for the various target behaviors during meals.
- 5. It is possible that food refusal could be maintained by either positive reinforcement (parental attention in various forms) or negative reinforcement (avoidance of food). Which of the contingencies used by the authors would need to be modified if food refusal were maintained by attention? How would it be modified?
- 6. Describe the fading strategy that was used to increase food texture.

- 7. The authors mentioned that they used a multiple baseline across subjects design to evaluate the effects of treatment. Which aspect of the treatment underwent systematic evaluation, and which sets of data showed systematic change as a function of treatment?
- 8. The authors suggested that food selectivity by texture may represent the outcome of several different problems. What are these problems, and to what extent would the fading procedure represent a potentially effective treatment for each?

Questions prepared by Gregory Hanley and Jana Lindberg, The University of Florida